de certaines espèces:

- protégées chimiquement, *Iule* (Diplopode), *Meloe* (Coléoptère) *Graphosoma* (Hémiptère) ...
- trop fortement chitinisées, *Blaps, Asida, Scaurus* (Coléoptères) *Glomeris* (Diplopode) ...
- dépassant un seuil critique de taille, gros Orthoptères, Vertébrés ...

Les animaux captifs boivent régulièrement. L'eau est fournie à volonté et renouvelée tous les deux jours.

IV. Conditions climatiques dans le local d'élevage

Les amplitudes thermiques du local d'élevage sont plus faibles qu'à l'extérieur (15 à 30° C), la température moyenne étant de 20° C environ. Pendant l'hiver, la pièce est chauffée (chauffage central). Des lampes à filaments de carbone sont en outre allumées dans le terrarium afin de maintenir un seuil thermique minimal de 15 à 16° C.

Le degré hygrométrique de l'air du local d'élevage varie de 40 à 90 %. Il demeure donc assez proche de celui de l'extérieur. Toutefois, l'emploi d'un humidificateur d'air est parfois nécessaire pendant les journées très chaudes et sèches de l'été. De plus, le sol du terrarium est régulièrement arrosé d'eau tout au long de l'année.

Une grande fenêtre dépourvue de volet permet le maintien des conditions lumineuses normales dans le local d'élevage. Un éclairage électrique est souvent utilisé pendant la nuit pour permettre de fournir la nourriture et d'observer les diverses séquences du comportement des animaux.

Dans le nid, une plaque de carton maintient une obscurité permanente dans tout le labyrinthe du bloc de plâtre. Une lanterne Kodak à lumière rouge-orangé, employée pour l'éclairage des laboratoires photographiques, permet d'observer l'intérieur du nid de plâtre sans perturber l'animal.

V. Conclusions

Des méthodes relativement simples, qui ressortent plus du "bricolage" et de la patience, que de la technique sophistiquée, montrent que la parfaite connaissance du milieu et du genre de vie d'une espèce est indispensable avant de réussir un élevage. Celui-ci mis au point, les observations éco-éthologiques deviennent possibles et les résultats offrent un maximum de sécurité. Cet élevage nous a permis de rassembler des données sur la reproduction, la mue, l'activité et, ce qui était impossible dans la nature, le comportement des individus (sexuel, maternel, alimentaire, etc. . . .).

Remerciements

Il m'est agréable de remercier Mme M.-C. Saint Girons, Maître de Recherche au C. N. R. S. qui m'a toujours guidé et encouragé, depuis le début de mon travail. Mon père et mon frère m'ont apporté leur aide lors de la confection des très nombreux pièges, abris et nids de plâtre, qu'ils trouvent ici l'assurance de toute mon affection.

Résumé

L'auteur décrit les méthodes de captures et d'élevage de la Pachyure étrusque, *Suncus etruscus* (Savi, 1822). Des pièges abris offrant à l'animal une litière et de la nourriture vivante, per-

mettent d'obtenir des individus en bon état. La reproduction de la Musaraigne étrusque au laboratoire est sans nul doute liée à l'emploi des nids à labyrinthe, offrant à l'animal des circulations souterraines très proches de celles employées dans la nature, et convenant parfaitement au comportement thigmotactique de l'animal.

Summary

Methods of capture and of rearing of the Etruscan shrew Suncus etruscus (Savi, 1822) (Insectivora, Soricidae).

The author describes the methods of capture and of rearing of the Etruscan shrew, *Suncus etruscus* (Savi, 1822). The shelter-traps offer to the animal a litter and live food which allow to collect the trapped animals in good conditions. The reproduction of this shrew in laboratory conditions is without any doubt due to the use of labyrinth nests giving to the animals underground circulations very similar to those they use in the wild and which correspond well to their thigmotactic behaviour.

Zusammenfassung

Methoden zum Fang und zur Zucht der Etruskerspitzmaus Suncus etruscus (Savi, 1822)

Methoden zum Fang und zur Zucht der Etruskerspitzmaus *Suncus etruscus* (Savi, 1822) werden beschrieben. Die Tiere überstehen den Fang gut, wenn die Lebendfalle Schutz von Nässe und Wind bietet, und sie darin Streu und Lebendfutter vorfinden. Für den Zuchterfolg war es zweifellos entscheidend, daß den Spitzmäusen ein den natürlichen Verhältnissen entsprechendes Gangsystem aus Gips geboten wurde.

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A comparative study of the chromosome banding patterns of *Mesocricetus newtoni* and *Mesocricetus auratus*

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Introduction

The significance of karyotype analysis for establishing phylogenetic relationships within or between different taxa has been clearly demonstrated, especially through the investigations, amongst others, by Matthey (1961, 1964), Nadler (1969) and Hsu and Arrighi (1966). Nevertheless, the restrictions of the techniques available have not always yielded conclusive results. Some attempts have been made to recognize homologies between the chromosomes of related species using idiograms. The most recent reports were those by Fredga (1972) for mongooses (Viverridae), and by Todd et al. (1972) for three hamster species within the genus *Mesocricetus*.

The recent special staining techniques (C-, G- and Q-banding) allow a superior identification of homologous chromosomes, and the individual chromosome pairs of every species can be differentiated. On the other hand, the chromosomal changes having occurred during evolution may be traced. Therefore, it may be possible to throw more light upon the mechanisms which determine the actual configuration of the karyotype of a particular species. Under this aspect we have performed a comparative study of the chromosome banding patterns of two hamster species belonging to the genus *Mesocricetus*.

The karyotype of the Syrian hamster (*Mesocricetus auratus* $2n = 44$) is well established (Galton and Holt 1964; Lehman et al. 1963; Fredga and Santesson 1964; Schmid 1967; Hsu and Arrighi 1971).

Raicu and Bratosin (1966) und Raicu et al. (1968) described the karyotype of the Rumanian hamster (*Mesocricetus newtoni*), having a diploid complement of 38 chromosomes. Recently the distribution of constitutive heterochromatin and the chromosomal banding pattern of this species has been reported by us (Voiculescu et al. 1972).

It is attempted here to establish the degree of concordance in the chromosomal banding patterns, and to discuss the possible mechanisms involved in karyotype differentiation of these two species.

Material and methods

The Rumanian hamster is a wild living animal of South-Eastern Rumania (The province Dobroudja) and Bulgaria, occuring in a very restricted location. The specimens used in this study were kindly supplied by Prof. P. Raicu and Dr. L. Manolache, Bukarest.

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Bone marrow air-dryed and flame-dryed chromosome preparations were produced for utilization of the C-staining and G-staining method, respectively.

The special staining for constitutive heterochromatin was performed according to the method described by ARRIGHI and HSU (1971).

Chromosomal G-banding patterns were obtained using the procedure described by SCHNEDL (1971) with some modifications. The Giemsa staining was made according to CHAUDHURI et al. (1971).

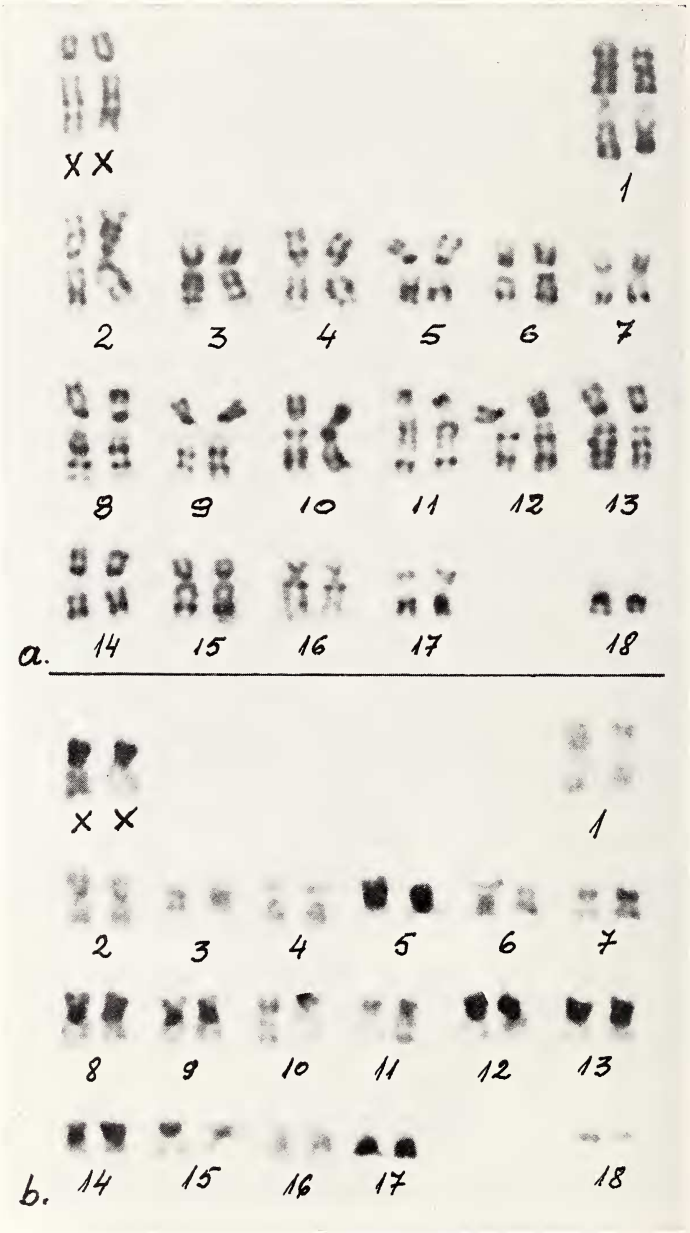

Fig. 1. Karyotype of the Rumanian hamster *(M. newtoni).*
a = G-banding pattern; b = C-banding pattern

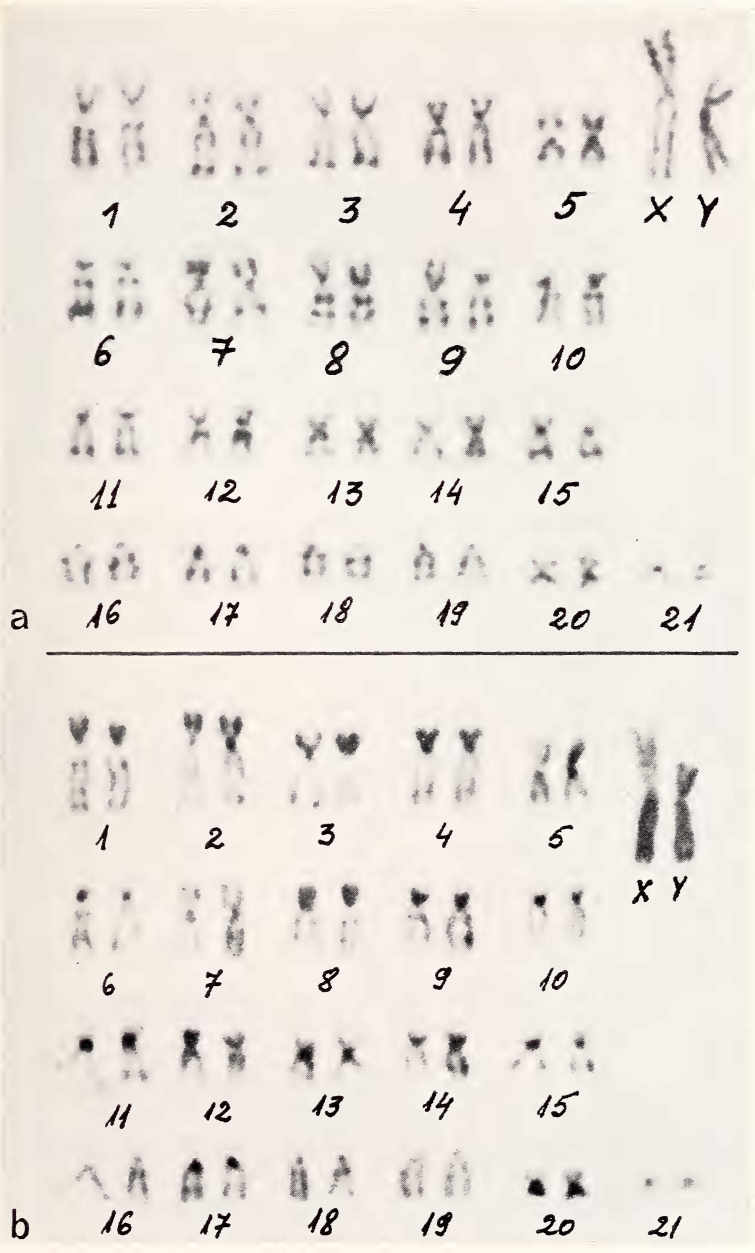

Fig. 2. Karyotype of the Syrian hamster *(M. auratus).*
a = G-banding pattern; b = C-banding pattern

Results

The chromosomal G-banding patterns of the two hamster species are illustrated in figs. 1a and 2a respectively. Since it will be demonstrated that the difference in fundamental number (FN) of these two species is due to differences in the distribu-

tion of constitutive heterochromatin, we present the localization of heterochromatin within he karyotypes in figs. 1b and 2b respectively, as obtained by the C-staining technique. In order to clearly identify the chromosomes of the Syrian hamster carrying entirely heterochromatic short arms, we have selected metaphases stained by the C-banding technique which also exhibited the G-banding pattern to a certain degree. In the Rumanian hamster this was not necessary since those particular chromosomes had already been identified in our recent report (Voiculescu et al. 1972). Fig. 3 shows the chromosomes of both species arranged in such a way that the banding patterns correspond to each other, indicating their presumed homology.

Taking into account that the Rumanian hamster has a lower number of chromosomes than the Syrian hamster, and that all the chromosomes are biarmed, the chromosomal set of this species is used as the basis for comparison. In the following we describe the homologies of the banding pattern between the chromosomes or chromosomal segments of the two species, as illustrated in fig. 3.

	Mesocricetus newtoni	*Mesocricetus auratus*
Chromosome 1:	— short arm	long arm of chromosome 1
	— long arm	long arm of chromosome 3

The short arms of chromosomes 1 and 3 of the Syrian hamster are heterochromatic (C-staining, fig. 2b). A very characteristic feature of chromosome 1 of the Syrian hamster is the presence of an unstained zone on the long arm near the centromere. This feature is also present on the short arm of chromosome 1 of the Rumanian hamster.

Chromosome 2:	— short arm	acrocentric chromosome 19
	— long arm	acrocentric chromosome 17

This is a typical example of centric fusion of the Robertsonian type.

Chromosome 3:	— short arm	long arm of chromosome 12
	— long arm	acrocentric chromosome 16

The short arm of chromosome 12 of the Syrian hamster is heterochromatic (C-staining, fig. 2b).

Chromosome 4:

It can be considered as homologous to chromosome 7 of the Syrian hamster. The different centromeric index is due to an additional telomeric heterochromatic band on the short arm of chromosome 4 of *M. newtoni.*

Chromosome 5:

The banding patterns correspond satisfactorily.

The short arm is longer in chromosome 5 of the Rumanian hamster, which results in a different cetromere index. The C-staining proves that the short arms of both chromosome pairs are heterochromatic.

Chromosome 6: Chromosome 5

An unstained zone on the short arms near the centromeres is a characteristic feature of these chromosomes.

Chromosome 7: Chromosome 15

The banding patterns prove the homology of these Chromosomes. The short arm of chromosome 7 *(M. newtoni)* has an additional telomeric heterochromatic band which results in a different centromeric index.

Chromosome 8: Chromosome 8

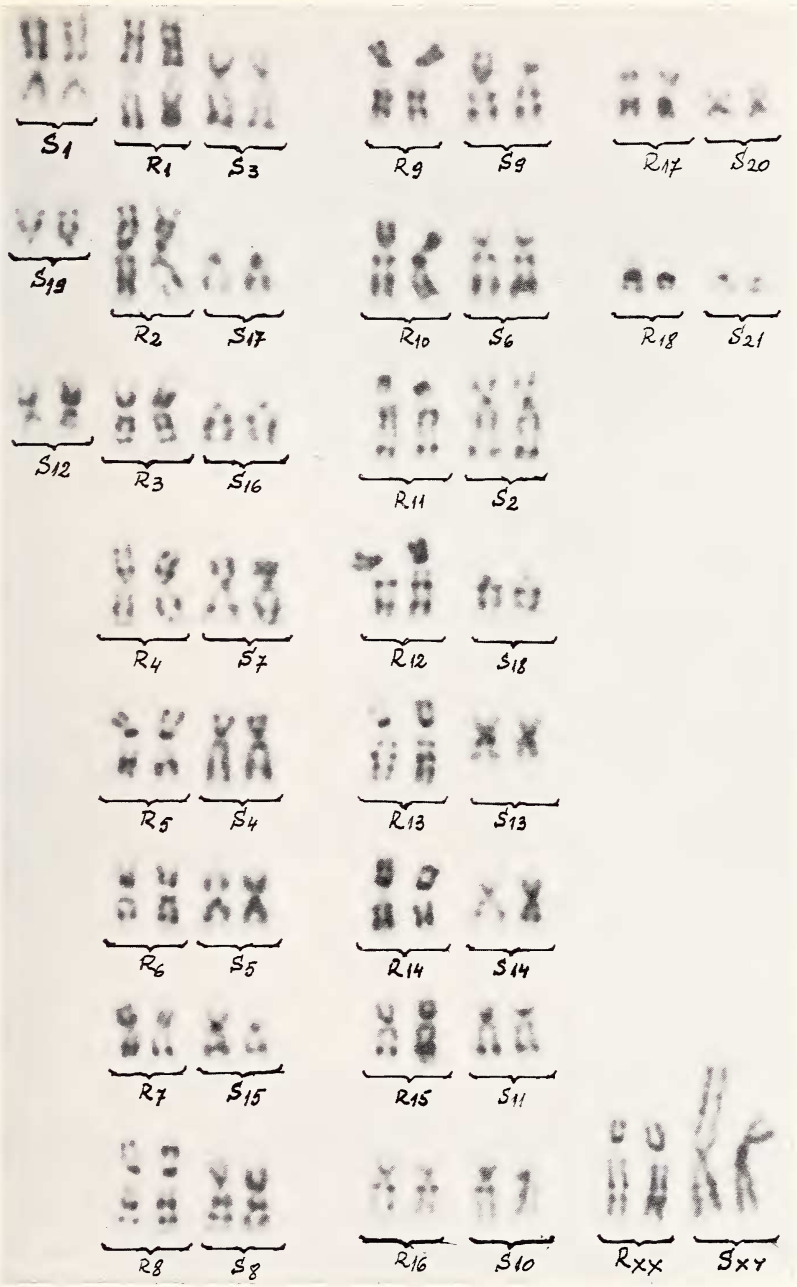

Fig. 3. Karyotypes of Rumanian and Syrian hamsters arranged in columns to show their presumed homology. R = Rumanian hamster; S = Syrian hamster

Chromosome 9: Chromosome 9

In the Rumanian hamster chromosomes 8 and 9 have a larger unstained region on the long arm near the centromere than the chromosomes 8 and 9 from the Syrian hamster.

Chromosome 10: Chromosome 6

Perfect homology exists between these two chromosomes. In the Rumanian hamster the short arm of chromosome 10 has an additional heterochromatic band at the telomere, emphasized by the C-staining (fig. 1b).

Chromosome 11: Chromosome 2

A large unstained region between the central and distal third of the long arms, and a small one on the short arms near the centromeres of both chromosomes are characteristic features. The short arms are unequal that of chromosome 2 being longer than that of chromosome 11, therefore the centromeric indices are different. The C-staining shows the short arm of chromosome 2 (Syrian hamster), and a telomeric band on the short arm of chromosome 11 (Rumanian hamster) to be heterochromatic (figs. 1b and 2b).

Chromosome 12:

— short arm heterochromatic (fig. 1b)

— long arm — acrocentric chromosome 18

Chromosome 13:

— short arm heterochromatic (fig. 1b)

— long arm — whole chromosome 13

Regarding chromosome 13 of the Syrian hamster, we presume a translocation of the short arm to the long arm (pericentric inversion) resulting in the long arm of chromosome 13 of the Rumanian hamster; then, banding patterns are in accordance with those of the long arm of chromosome 13 (Rumanian hamster) (fig. 4).

Chromosome 14:

— long arm — long arm of chromosome 14

The short arms are heterochromatic (C-staining). On the long arm of chromosome 14 of the Rumanian hamster an unstained zone near the centromere exists resulting in a different centromeric index.

Chromosome 15:

— long arm — long arm of chromosome 11

The short arm of chromosome 15 is heterochromatic (fig. 1b) and longer.

Chromosome 16: Chromosome 10

Chromosome 17:

As in the chromosome 14 of the Rumanian hamster, the long arm of chromosome 17 exhibits an unstained zone near centromere, resulting in a different centromeric index.

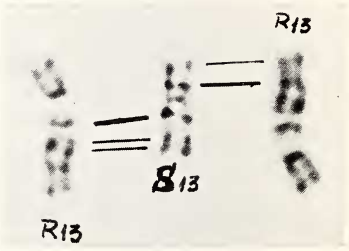

Fig. 4. Pericentric inversion on chromosome 13 of the Syrian hamster (S 13); the corresponding bands are located in the long arm of chromosome 13 of the Rumanian hamster (R 13).

Chromosome 18: Probably chromosome 21

Chromosome X:

There is good homology in the euchromatic segments, which posses two characteristic bands each. This banding pattern seems to be a general feature of the eutherian X-chromosome. We have observed an identical banding pattern in *Microtus agrestis* and in *Mus musculus*.

Chromosome Y:

In both species the Y-chromosomes are heterochromatic and show no banding pattern.

Discussion

In a recent report YERGANIAN (1972), refering to the species *Mesocricetus auratus* (2n = 44), *Mesocricetus brandti* (2n = 42) and *Mesocricetus newtoni* (2n = 38) suggested that: „one cannot judge whether the trend in speciation followed a numerical increase, i. e., 38—42—44, or numerical decrease, i. e., 44—42—38 in the number of chromosomes".

Indeed, not even the banding methods offer more precise clues to this question. The analysis of the banding pattern reveals only the extent of concordance, and not the trend of speciation in the two species examined here. Arbitrarily, we consider the karyotype with 2n = 44 as the ancestral one. In favour of this assumption is the occurence of one Robertsonian translocation, two accrocentrics of the Syrian hamster forming one metacentric of the Rumanian hamster. However, this as well as the other mechanisms discussed subsequently, can also be interpreted conversely. A more comprehensive study including all the species that belong to the genus *Mesocricetus,* could possibly give closer information on the trend of speciation within this genus.

The results of our study demonstrate a good correspondence in the banding patterns either of whole chromosomes, or of chromosomal segments of the Rumanian and Syrian hamsters.

Refering to the possible mechanisms that occured during speciation of hamsters, WURSTER et al. (1971) supposed that Robertsonian fusions played an insignificant part, inversions and translocations being more important. Our results confirm this opinion. We identified only one translocation of the Robertsonian type, i. e. the metacentric chromosome 2 of the Rumanian hamster resulting from a centric fusion of the acrocentric chromosomes 19 and 17 of the Syrian hamster. In another two presumptive translocations which resulted in the chromosomes 1 and 3 of the Rumanian hamster, the long arms of two submetacentrics, and the long arm of a submetacentric together with an acrocentric chromosome were involved respectively. The C-staining proved that the short arms of all the 3 submetacentrics participating in translocations are heterochromatic. Therefore, from these 3 translocations six heterochromatic short arms remain in the Syrian hamster, while being unpaired in the Rumanian hamster.

The fundamental number (FN) is 80 for the Syrian hamster and 76 for the Rumanian hamster. WURSTER et al. (1971) gave a FN = 78 for the Syrian hamster, probably because they considered chromosome pair no. 21 as being uniarmed. Since in the Rumanian hamster the chromosome pair no. 18 is alike and probably homologous to no. 21 of the Syrian hamster, we consider both chromosome pairs to be biarmed, giving a FN = 80 for the latter.

Taking into account that chromosome 12 of the Rumanian hamster has a heterochromatic short arm in contrast to the corresponding chromosome 18 of the Syrian hamster (which is acrocentric), only four of the six heterochromatic short arms in the Syrian hamster mentioned above are left, resulting in the difference in the FN of the two species. The resumed pericentric inversion of chromosome 13 of the Syrian hamster, resulting in the long arm of chromosome 13 of the Rumanian hamster, does not modify the FN, since, in addition, chromosome 13 of the Rumanian hamster has a heterochromatic short arm.

Our analysis revealed the presence of additional telomeric heterochromatic bands on the short arms of some of the chromosomes (the chromosomes 4, 5, 7, 10, 15 of *M. newtoni* compared to 7, 4, 15, 6, 11 of *M. auratus* respectively, and a longer short arm of chromosome 2 of *M. auratus* compared to the short arm of chromosome 11 of *M. newtoni).* From these observations, it could be concluded that of the four hete-